Brucellosis of Livestock*

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THERE is probably no disease of animals in the United States at the present time that constitutes a more serious threat to public health than brucellosis. Certainly the human brucellosis cases reported each year cannot be disregarded any more than the estimated $100 million annual loss suffered by the livestock industry because of brucellosis in animals. In view of the obvious economic and public health benefits that can be expected from the elimination of brucellosis in animals, there is every reason for all interested groups to support the eradication program.

Within the past few years increasing public health interest in brucellosis has been favorably reflected in the field operations dealing with brucellosis of livestock. The average producer is showing more concern than ever before about the hazards of *Brucella*-infected animals to the health of his immediate family. This attitude is establishing a foundation for the type of coöperative effort essential to successful promotion of the brucellosis project. In fact, the interest, displayed by producers and consumers alike, for eradicating this disease is greater now than at any time since the first organized control effort was started back in 1934.

From the standpoint of public health aspects of brucellosis, the statement, "If there were no infected animals, there would be no infected human beings," seems to be most appropriate in summing up the entire situation. The brucellosis problem is clear-cut in so far as the interrelationship of human health and economics is concerned. Such being the case, it is essential that public health agencies, livestock sanitary groups, and the livestock industry combine their efforts to eradicate the disease. No single group can hope to accomplish too much alone, and the mutual interests that will be served by eventual eradication of brucellosis are adequate inducements for full coöperation.

INCIDENCE OF BRUCELLOSIS IN LIVESTOCK

When the first organized effort to control and eradicate bovine brucellosis was started in 1934, it was estimated that approximately 12 per cent of the cattle in the United States were infected. On the basis of current records covering results of federal-state coöperative testing, it would appear that somewhat less than 4 per cent of adult female cattle are now affected with the disease. With minor exception, the degree of infection is rather constant throughout the country and does not seem to vary between areas as much as might be expected, considering the vast differences in animal husbandry that exist.

Data on the extent of swine brucellosis are too limited for anything more than tentative estimates. Moreover, the inadequacies of the blood agglutination test for diagnosing the disease in individual swine has hindered to some

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extent the collection of such information. Preliminary surveys conducted in several midwestern states indicate a much lower incidence of *Brucella* infection in swine than was originally found in cattle. Although sectional variations have been noted, an overall estimate of 2 to 3 per cent seems reasonable at this time.

As in the case of swine brucellosis, the information on *Brucella* infection in goats is also inadequate. So far as we know, *B. melitensis* infection of goats is confined largely to the southwestern states, where most of the goat population in this country is found. The most extensive testing of goats for brucellosis in the United States was carried out in Colorado during the period 1944 through 1947. The highest incidence reported on this project was around 8 per cent, found during the first year. By repeated testing and removal of reacting animals, this figure was reduced in three years to about 1.5 per cent.

Occasional reports are received from Bureau Veterinarians in Charge covering tests made on goats at owner's request. For the area east of the Mississippi River, these reports show very little evidence of *B. melitensis* infection.

For many years it was generally believed that the three recognized *Brucella* types were highly specific for the animal species involved, namely, *B. abortus* for cattle, *B. suis* for swine, and *B. melitensis* for goats. However, a wide range of cross-infections have recently been found occurring under natural conditions. For example, several well documented, milk-borne undulant fever epidemics have been traced to unpasteurized milk from cattle shown to be harboring *B. suis* as an udder infection. Even though research has failed to find an easy method of artificially establishing *B. suis* infection in cattle, it certainly does occur in the field and should be considered in the brucellosis program.

B. melitensis has been identified in cattle only on rare occasions. However, it is reasonable to believe that the infrequency with which it has been isolated is due more to the relatively slight possibility of exposures in this country than to anything else.

B. melitensis has also been identified in swine, but very little is known at the present time about the frequency with which it may occur. Nevertheless, the fact that swine are susceptible in some degree to *B. melitensis* is reason enough to encourage further study of this problem. There has been considerable doubt in several field cases as to the origin of the *B. melitensis* infection involved.

More recently, conclusive evidence has been found that *B. abortus* can occur as a natural infection in swine. This discovery is highly significant from the standpoint of control and eradication of bovine brucellosis and could explain the difficulties encountered in cleaning up some cattle herds.

The elimination of *Brucella*-infected cattle identified by the blood serum agglutination test has been practised extensively over the past 15 years and the test has been found effective when properly employed. The usefulness of the agglutination test as a diagnostic procedure has been established beyond question. There are limitations, of course, in this as well as in all biological tests, but with the present standardization of techniques and materials, these limitations have been reduced to a negligible point.

While Strain 19 vaccination of calves is by no means the full solution to the brucellosis problem, intelligent use of the product can help materially in working toward the goal of eradication by limiting the spread of infection in otherwise susceptible animals. One of the greatest mistakes associated with the use of vaccine has been its too frequent acceptance as a panacea or as an easy way out of a difficult situation. The fact that the protection afforded by Strain 19 is relative and not absolute has been over-

looked many times with disastrous results. Several factors may modify the duration and serviceability of vaccinal resistance. Included among these are (a) virulence of the organism, (b) degree of exposure, and (c) the response of the individual to vaccinal stimulation.

Experience gained over the years from field operations shows that no single procedure is equally suitable for eradicating brucellosis in all herds. Because one method was successful in tuberculosis eradication, many believed the same principle would apply to brucellosis, ignoring the fact that two entirely different diseases were involved. The fact that best results from either test-and-slaughter or vaccination are obtained under conditions which are quite unlike is proof that the tools for a program flexible enough to meet the requirements of any herd are available. It must be remembered, however, that regardless of the initial practices employed, final eradication must depend on the elimination of residual centers of infection through removal of reactors to the blood agglutination test.

UNIFORM BRUCELLOSIS ERADICATION PROGRAM

The need for unifying the brucellosis eradication program was recognized long before any concerted action was taken to bring this about. Finally, as a result of determined efforts made by many interested groups, a uniform program for the eradication of bovine brucellosis was adopted by the U. S. Livestock Sanitary Association at its annual meeting in December, 1947. With minor amendments, made in 1948 and 1949, the present program has gradually evolved from those original recommendations. While it is by no means perfect, the outline has provided a rallying point for those sincerely interested in the development of an effective brucellosis eradication program.

These recommendations have been approved by the Bureau of Animal Industry and provide the basis for federal-state coöperation on the brucellosis eradication project. Nearly all the states have agreed to work toward full compliance with the requirements of the uniform program.

The four plans incorporated in the uniform program may be reviewed briefly:

Plan A: Test-and-slaughter, with or without calf vaccination—This plan has been used successfully in cleaning up thousands of herds. The problems encountered with its employment are frequently greatest in herds where numerous replacements from outside sources are required. Difficulties may also be experienced in highly susceptible herds where virulent infection has recently been introduced. The so-called "test-and-slaughter" method has eradication of the disease as its immediate goal and is the method of initial choice where the incidence of infection is low and herds are self-contained.

Plan B: Test, calf vaccination, temporary retention of reactors—The procedures employed in this plan were set up to cover those herds which, because of a high incidence of infection, might be forced out of business by a straight test-and-slaughter program. When this plan is followed in the recommended manner, sufficient offspring should be available within a period of four or five years to permit replacement of the entire adult herd with vaccinated stock and adoption of *Plan A*. *Plan B* has been very popular throughout the country and is widely used. Its greatest weakness is the lack of limitations placed on the length of time that adult reacting animals can be retained in the herd. There is reason to believe that this fault will be corrected within the near future.

Plan C: Calf vaccination without test of any part of the herd—This plan was designed to encourage range people to

participate in some type of brucellosis program, with the hope that later they would work toward more effective procedures. *Plan C* is confined to herds where the movement of animals is restricted through special permits issued by state livestock sanitary officials.

Plan D: Adult vaccination—Within the framework of these recommendations, adult vaccination is permitted only on approval of state and federal coöperating agencies. This plan was incorporated in the outline only as a possible means of counteracting unofficial vaccination of adult cattle.

While the resistance induced in healthy adult cattle by vaccination with Strain 19 is at least as great as that induced in calves, the resulting blood agglutination reactions tend to persist for indefinite periods. Because these reactions are indistinguishable from those associated with virulent infection, the vaccination of mature cattle automatically places such animals in a class where their true status cannot be determined. Moreover, in the presence of rapidly spreading infection—the condition under which adult vaccination is most frequently practised—little if any benefit can be expected.

At the present time there are no national programs in operation for the eradication of brucellosis from other livestock species, although we may be reaching the point where such projects will be essential. Within the past few years sufficient information has been assembled on swine brucellosis to permit the development of recommendations for the control and eradication of this disease. The results of preliminary field trials, based on these recommendations, are very encouraging and suggest that a practical method for the elimination of *B. suis* infection from swine may be available. The blood agglutination test is not as accurate in diagnosing brucellosis in individual hogs as it is in cattle. However, its use as a herd diagnostic procedure, coupled with segregation of weanling pigs from adult stock, is proving effective in swine brucellosis eradication.

Evidence from area work conducted in Colorado shows that elimination of goats which react to the blood agglutination test for brucellosis is effective in eradicating *B. melitensis* infection from relatively large herds. However, goats reacting in titers as low as 1:25 must be classed as infected, especially in known infected herds, because of the generally rapid decline of Brucella blood agglutination titers in these animals.

Strain 19 vaccine does not provide serviceable resistance in either goats or hogs against *B. melitensis* or *B. suis* exposures.

PRESENT STATUS OF BRUCELLOSIS ERADICATION

During the fiscal year ending June 30, 1950, a total of almost 6 million cattle were officially tested for brucellosis. Of this number, 3.5 per cent were classed as reactors. Not only is this the largest number of cattle tested during any year since 1942, when the war interfered with operations, but the percentage of infection disclosed is lower than at any time during the same period. For the fiscal year 1949, the infection was 4.0 per cent.

It is also interesting to note a corresponding reduction in the percentage of infected herds. For the fiscal year 1948, 18.2 per cent of the herds tested were infected. In 1949 this figure dropped to 16.3, and in 1950 was reduced still further, to 13.9 per cent.

We now have three states, North Carolina, New Hampshire, and Maine, with all counties qualified as "Modified Certified Brucellosis-Free Areas," and there is growing interest on the part of other states to achieve this goal.

As has been true each year since 1940, when vaccination was given official

recognition, the number of official vaccinations increased materially during the past fiscal year, reaching an all-time high of 2,065,063, an increase of about 30 per cent over the previous year.

SUMMARY AND CONCLUSIONS

While it is true that some individuals as well as groups still think only in terms of brucellosis control, there is growing enthusiasm for complete eradication of the disease. Increasing numbers of herd owners throughout the country are recognizing the economic and public health benefits to be derived from brucellosis-free herds.

For many years the brucellosis project has been hindered by the lack of unified effort. Wide differences in views presented a serious obstacle to the promotion of an effective program. As a result of action taken by various agencies and groups within recent years, however, progress has been made in developing a national brucellosis program along uniform lines. The fact that 42 of the 48 states have subscribed to the principles outlined in the new federal-state "Memorandum of Understanding" for brucellosis eradication in livestock is evidence of the advances being made in standardizing procedures.

The shortage of trained personnel is still a serious obstacle to rapid advancement of brucellosis eradication. From the results of continuing research on the ABR or ring test, there are prospects that this procedure will eventually prove to be a valuable adjunct to the blood agglutination test and a means of economically meeting the demands for expanded service. On the basis of studies made in Minnesota, it is estimated that counties having moderate to low infection can be ring-tested for about 10 per cent of the cost of blood testing the same areas. This mainly reflects savings in man-hour requirements. Everyone is hopeful that further research will confirm earlier results and will provide the additional information needed to evaluate the test conclusively.

With the recognition of relatively wide-scale interspecies transmission of *Brucella* types, it becomes more important than ever that all susceptible livestock groups be given serious consideration in the brucellosis eradication program. There is no doubt but that *Brucella* infections can be eliminated with the procedures we now have at our disposal. Although we are advancing more slowly than could be desired, year-by-year records continue to show encouraging progress. With the present growing support being given the project by most interested groups, there is reason to believe that we are approaching the point where maximum accomplishment will be assured.